This bulletin also applies to RCA-5763 which is identical with RCA-6417 except for its heater rating of 6.0 ± 10% volts, 0.75 ampere.

6417

VHF BEAM POWER TUBE

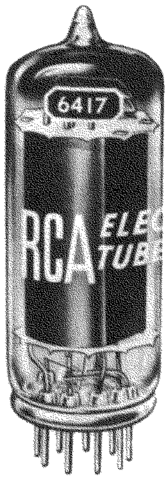
High Transconductance
High Power Sensitivity

9-Pin Miniature Type
Full Input to 50 Mc
13.5-Watt ICAS Plate Dissipation

2-5/8" Max. Length
7/8" Max. Diameter

TENTATIVE DATA

RCA-6417 is a general-purpose transmitting beam power tube of the heater-cathode type intended for use in compact, low-power mobile and portable transmitters and in emergency communications equipment operating directly from 12-volt storage batteries. It can also be used in the low-power stages of larger fixed station transmitters. The 6417 can be operated with full input up to 50 megacycles per second and with reduced input up to 175 megacycles per second.



Because of its high transconductance, and a plate characteristic favorable to the generation of a high harmonic output, the 6417 is particularly useful in the doubler and tripler stages of transmitters. Because of its high perveance, this tube can supply high power output at relatively low supply voltages. These features in addition to its high power sensitivity make the 6417 especially useful as an rf power amplifier, frequency multiplier, oscillator (VFO or crystal), and as a vhf driver tube for larger tube types.

Featured in the design of the 6417 are heavy control-grid support rods and two control-grid base-pin connections which provide for cooler grid operation; a cathode with a large area to supply the high peak currents required for multiplier service; and a 12.6-volt heater which can be conveniently operated from a storage battery.

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	12.6 ± 10%	volts
Current.	0.375	amp
Transconductance for dc plate current of 45 ma, dc plate voltage of 250 volts, and dc grid-No. 2 voltage of 250 volts.	7000	μmhos
Mu-Factor, Grid No. 2 to Grid No. 1 . . .	16	
Direct Interelectrode Capacitances:*		
Grid No. 1 to Plate	0.3 max.	μμf
Input.	9.5	μμf
Output	4.5	μμf

Mechanical:

Mounting Position.	Any
Maximum Overall Length	2-5/8"
Maximum Seated Length.	2-3/8"
Length from Base Seat to Bulb Top (Excluding tip)	2" ± 3/32"
Maximum Diameter	7/8"
Bulb	T-6-1/2"
Base	Small-Button Noval 9-Pin (JETEC No. E9-1)

PLATE-MODULATED RF POWER AMP. - Class C Telephony

Carrier conditions per tube for use with a max. modulation factor of 1.0

	CCS•	ICAS••	
Maximum Ratings, *Absolute Values*:			
DC PLATE VOLTAGE	250 max.	300 max.	volts
DC GRID-No. 3 (SUPPRESSOR) VOLTAGE	0 max.	0 max.	volts
DC GRID-No. 2 (SCREEN) VOLTAGE	250 max.	250 max.	volts
DC GRID-No. 1 (CONTROL-GRID) VOLTAGE	-125 max.	-125 max.	volts
DC PLATE CURRENT	40 max.	50 max.	ma
DC GRID-No. 2 CURRENT	15 max.	15 max.	ma
DC GRID-No. 1 CURRENT	5 max.	5 max.	ma
PLATE INPUT.	10 max.	15 max.	watts
GRID-No. 2 INPUT.	1.5 max.	1.5 max.	watts
PLATE DISSIPATION.	8 max.	12 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode . . .	100 max.	100 max.	volts
Heater positive with respect to cathode . . .	100 max.	100 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface). .	250 max.	250 max.	°C
Typical Operation up to 30 Mc:			
DC Plate Voltage	250	300	volts
Grid No. 3.	Connected to cathode at socket		
DC Grid-No. 2 Voltage## . . .	250	250	volts
DC Grid-No. 1 Voltage□ . . .	-39	-42.5	volts
From a grid resistor of . .	39000	18000	ohms
Peak RF Grid-No. 1 Voltage. .	46.5	53.5	volts
DC Plate Current	40	50	ma
DC Grid-No. 2 Current	5.6	6	ma
DC Grid-No. 1 Current (Approx.)	1	2.4	ma
Driving Power (Approx.). . .	0.05	0.15	watt
Useful Power Output (Approx.)	6.4♦	10♦	watts
Maximum Circuit Values (For maximum rated conditions):			
Grid-No. 1-Circuit Resistance	0.1 max.	0.1 max.	megohm

RF POWER AMP. & OSC. - Class C Telegraphy▲ and RF POWER AMPLIFIER - Class C FM Telephony

Maximum Ratings, *Absolute Values*:	*CCS*●	*ICAS*●●	
DC PLATE VOLTAGE	300 max.	350 max.	volts
DC GRID-NO.3 (SUPPRESSOR) VOLTAGE	0 max.	0 max.	volts
DC GRID-NO.2 (SCREEN) VOLTAGE	250 max.	250 max.	volts
DC GRID-NO.1 (CONTROL-GRID) VOLTAGE	-125 max.	-125 max.	volts
DC PLATE CURRENT	50 max.	50 max.	ma
DC GRID-NO.2 CURRENT	15 max.	15 max.	ma
DC GRID-NO.1 CURRENT	5 max.	5 max.	ma
PLATE INPUT.	15 max.	17 max.	watts
GRID-NO.2 INPUT.	2 max.	2 max.	watts
PLATE DISSIPATION.	12 max.	13.5 max.	watts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode . . .	100 max.	100 max.	volts
Heater positive with respect to cathode . . .	100 max.	100 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface). .	250 max.	250 max.	°C

Typical Operation up to 30 Mc:

DC Plate Voltage	300	350	volts
Grid No.3.	Connected to cathode at socket		
DC Grid-No.2 Voltage	250	250	volts
DC Grid-No.1 Voltage# . . .	-28.5	-28.5	volts
From a grid resistor of. .	18000	18000	ohms
Peak RF Grid-No.1 Voltage. .	37.5	37	volts
DC Plate Current	50	48.5	ma
DC Grid-No.2 Current	6.6	6.2	ma
DC Grid-No.1 Current (Approx.)	1.6	1.6	ma
Driving Power (Approx.). . .	0.1	0.1	watt
Useful Power Output (Approx.)	10.3♦	12♦	watts

Typical Operation at 50 Mc:

DC Plate Voltage	300	-	volts
Grid No.3	Connected to cathode at socket		
DC Grid-No.2 Voltage	250	-	volts
DC Grid-No.1 Voltage# . . .	-60	-	volts
From a grid resistor of. .	22000	-	ohms
Peak RF Grid-No.1 Voltage. .	80	-	volts
DC Plate Current	50	-	ma
DC Grid-No.2 Current	5	-	ma
DC Grid-No.1 Current (Approx.)	3	-	ma
Driving Power (Approx.). . .	0.35	-	watt
Useful Power Output (Approx.)	7♦	-	watts

Maximum Circuit Values (For maximum rated conditions):

Grid-No.1-Circuit Resistance	0.1 max.	-	megohm

FREQUENCY MULTIPLIER

Maximum CCS● Ratings, *Absolute Values*:		
DC PLATE VOLTAGE	300 max.	volts
DC GRID-NO.3 (SUPPRESSOR) VOLTAGE. . .	0 max.	volts
DC GRID-NO.2 (SCREEN) VOLTAGE.	250 max.	volts
DC GRID-NO.1 (CONTROL-GRID) VOLTAGE. .	-125 max.	volts
DC PLATE CURRENT	50 max.	ma
DC GRID-NO.2 CURRENT	15 max.	ma
DC GRID-NO.1 CURRENT	5 max.	ma
PLATE INPUT.	15 max.	watts
GRID-NO.2 INPUT.	2 max.	watts
PLATE DISSIPATION.	12 max.	watts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	100 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	250 max.	°C

Typical Operation:

	Doubler to 175 Mc	*Tripler to 175 Mc*	
DC Plate Voltage	300	300	volts
Grid No.3.	Connected to cathode at socket		
DC Grid-No.2 Voltage . .	**	**	volts
DC Grid-No.1 Voltage# .	-75	-100	volts
From a grid resistor of.	75000	100000	ohms
Peak RF Grid-No.1 Voltage	95	120	volts
DC Plate Current	40	35	ma
DC Grid-No.2 Current . .	4	5	ma
DC Grid-No.1 Current (Approx.)	1	1	ma
Driving Power (Approx.).	0.6	0.6	watt
Useful Power Output (Approx.)	2.1♦	1.3♦	watts

Maximum Circuit Values (For maximum rated conditions):

Grid-No.1-Circuit Resistance	0.1 max.	0.1 max.	megohm

MAXIMUM RATINGS vs OPERATING FREQUENCY

FREQUENCY	50	175		Mc
MAX. PERMISSIBLE PERCENTAGE OF MAX. RATED PLATE VOLTAGE AND PLATE INPUT:		*Voltage*	*Input*	
Class C Telephony, Plate Modulated	100	100	80	per cent
Class C Telegraphy	100	100	80	per cent
Class C FM Telephony	100	100	80	per cent
Frequency Multiplier	100	100	80	per cent

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.345	0.405	amp
Grid No.1-to-Plate Capacitance	2	-	0.3	μμf
Input Capacitance.	2	8	11	μμf
Output Capacitance	2	3.8	5.2	μμf
Transconductance	1,3	5100	8900	μmhos
Plate Current.	1,3	33	57	ma
Grid-No.2 Current.	1,3	-	10	ma
Reverse Grid-No.1 Current. .	1,4	-	2	μamp

NOTE 1: With 12.6 volts ac or dc on heater.

NOTE 2: With no external shield.

NOTE 3: With dc plate voltage of 250 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage of -7.5 volts.

NOTE 4: With dc plate voltage of 250 volts, dc grid-No.2 voltage of 250 volts, dc grid-No.1 voltage of -7.5 volts, and grid-No.1-circuit resistance of 0.1 megohm.

* With no external shield.

● Continuous Commercial Service.

●● Intermittent Commercial and Amateur Service.

Obtained preferably from a separate source modulated with the plate supply, or from the modulated plate supply through a series resistor.

▲ Key down conditions per tube without amplitude modulation. Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115 per cent of the carrier conditions.

□ Obtained from grid-No.1 resistor or from a combination of grid-No.1 resistor with either fixed supply or cathode resistor.

♦ This value of useful power is measured at load of output circuit.

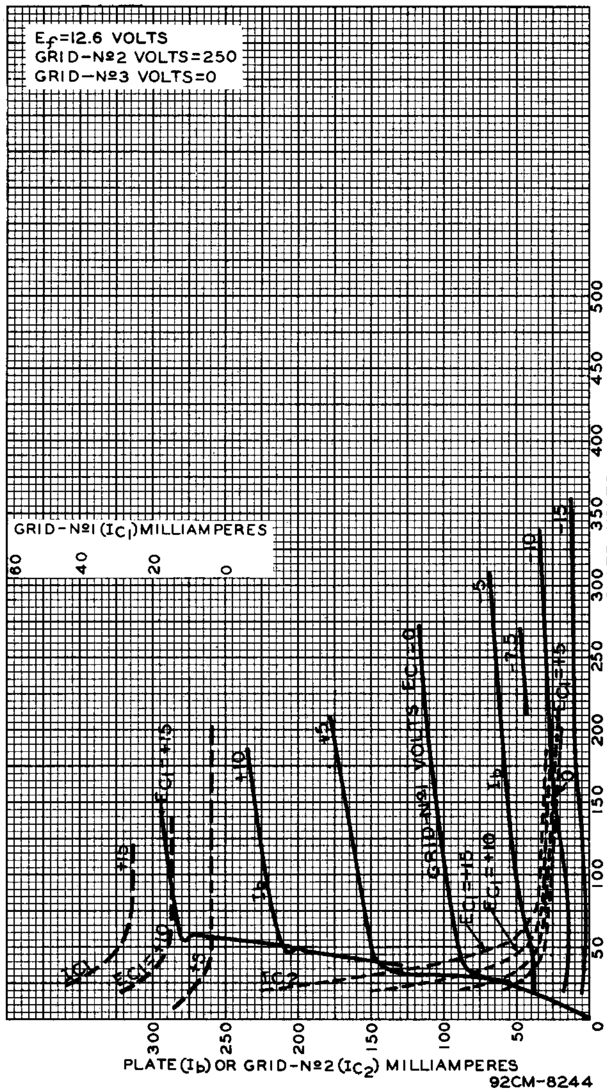
\# Obtained from a fixed supply, or by a grid-No.1 resistor of value shown.

** Obtained from plate supply voltage of 300 volts through a series resistor of 12500 ohms.

INSTALLATION AND APPLICATION

The *maximum ratings* are limiting values above which the serviceability of the 6417 may be impaired from the viewpoint of life and satisfactory performance. Therefore, in order not to exceed these absolute ratings, the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by an amount such that the absolute values will never be exceeded under any usual conditions of supply-voltage variation, load variation, or manufacturing variation in the equipment itself.

The 6417 can be operated at full input up to 50 megacycles. It is recommended that it be used as a frequency multiplier rather than as a straight-through amplifier at frequencies above 135 megacycles, in order to avoid excessive driving power due to high-frequency input loading.



Average Characteristics of Type 6417 with E_{c_1} as Variable.

Heavy leads and conductors together with suitable insulation should be used in all parts of the rf plate tank circuit so that losses due to rf voltages and currents may be kept at a minimum. At the higher frequencies, it is essential that short, heavy leads be used for circuit connections in order to minimize lead inductance and losses.



Average Plate Characteristics of Type 6417 with E_{c_2} as Variable.

The *base pins* of the 6417 fit the noval socket. The socket may be mounted to hold the tube in any position.

If the 6417 is to be used in aircraft transmitters at high altitudes, it is recommended that the socket clip corresponding to pin No.2 be removed. Removal of this clip will help to insulate the plate (pin No.1) from grid No.3 (pin No.3) and thus prevent any flashover.

The *bulb* becomes hot during continuous operation and, therefore, free circulation of air around the

tube should be provided. If a tube shield is used, it is advisable to paint the inside and outside surface of the shield a mat black, and to provide ventilation slots in order to prevent the temperature at the hottest point of the bulb surface from exceeding 250° centigrade.

Grid No.1 of the 6417 is designed with heavy support rods, and has 2 pin connections (pins 8 and 9) to permit cooler grid operation. In operating the 6417, it is essential that both grid-No.1 pins be connected into the circuit.

In *plate-modulated class C rf power amplifier service*, the 6417 should be supplied with bias from a grid-No.1 resistor or from a suitable combination of grid-No.1 resistor and fixed supply or grid-No.1 resistor and cathode resistor. The cathode resistor should be bypassed for both audio and radio frequencies. The combination method of grid-resistor and fixed supply has the advantage of not only protecting the tube from damage through loss of excitation but also of minimizing distortion by bias-supply compensation.

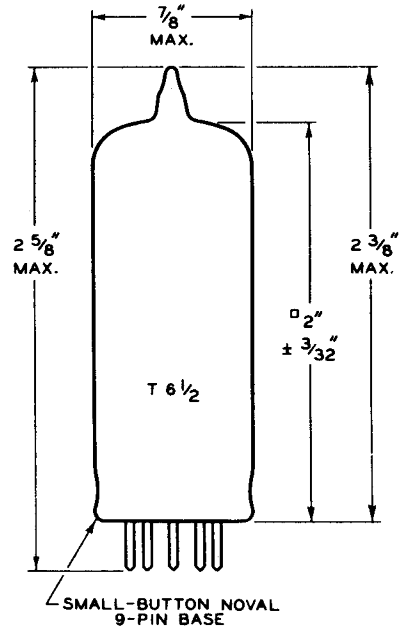
In *class C rf telegraphy and class C FM telephony service*, the 6417 should be operated with grid-No.1 bias obtained from a fixed supply or from a grid-No.1 bias resistor. The use of a grid-No.1 resistor is preferred because the bias is automatically adjusted as the load on the circuit varies. Because of the high amplification factor of the 6417, a small cathode resistor of 68 ohms can furnish sufficient voltage to protect the tube in the event of excitation failure and resultant loss in developed bias. The cathode bias of 3 volts required for protection is sufficiently small to make the dc plate power loss an unimportant factor.

The *driver stage* for the 6417 in either class C telephony or telegraphy service should have considerably more output capability than the typical tube driving power shown in the tabulated data in order to permit considerable range of adjustment and also to provide for losses in the grid-No.1 circuit and the coupling circuits. This recommendation is particularly important near the maximum rated frequency where there are other losses of driving power, such as circuit losses, radiation losses, and transit-time losses.

Highest operating efficiency in high-frequency service, and therefore maximum power output, will be obtained when the 6417 is operated under load conditions such that the maximum rated plate current flows at the plate voltage which will give maximum rated input.

Push-pull or parallel circuit arrangements can be used when more radio-frequency power is required than can be obtained from a single 6417. Two 6417's in parallel or push-pull will give approximately twice the power output of one tube. The parallel connection requires no increase in exciting voltage necessary to drive a single tube. With either connection, the driving power required is approximately twice that for a single tube. The push-pull arrangement has the advantage of simplifying the balancing of high-frequency circuits. When two or more tubes are used in the circuit, precautions should be taken to insure that each tube draws the same plate current.

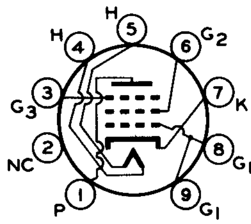
DIMENSIONAL OUTLINE



JETEC No. E9-1

□ MEASURED FROM BASE SEAT TO BULB-TOP LINE AS DETERMINED BY RING GAUGE OF 7/16" I.D.

SOCKET CONNECTIONS
Bottom View



9K

PIN 1: PLATE
PIN 2: NO CONNECTION
PIN 3: GRID No.3
PIN 4: HEATER
PIN 5: HEATER
PIN 6: GRID No.2
PIN 7: CATHODE
PIN 8: GRID No.1
PIN 9: GRID No.1